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HEATER

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Specification

1. Title of the Invention

Heater

2. Scope of Claims for Patent

(1) A heater comprising a heat generating element which has a continuous band-shaped heat generating portion formed on a plane with an arbitrary width.

(2) The heater according to claim 1, wherein the heat generating element has an arrangement in that the heat generating portion is continuously formed by selectively forming gaps in a heat generating material plate having an arbitrary shape.

(3) The heater according to claim 1, wherein the heat generating element has an arrangement in that the heat generating portion is formed into a staggered shape, a spiral shape or a radial shape with an arbitrary width.

3. Detailed Description of the Invention

[Industrial Applicable Field]

The invention relates to a heater for heating a subject to be heated such as a semiconductor wafer. More particularly, the invention relates to a shape of a heat generating portion of a heat generating element.

[Prior Art]

Conventionally, in a heating process for a semiconductor

wafer made of a material such as gallium-arsenide and phosphor-aluminum, for example, a heater, shown in Fig. 8, is used as a heating source.

This heater has an arrangement in that a heat generating element 6 is formed by rolling up a heat generating resistance band 2 prepared by forming a heat generating resistor that generates heat upon electric conduction into a band shape, with an insulating member 4 interpolated therein, and this heat generating element 6 is housed in a ceramic container 8, with a thermocouple 10 serving as temperature measuring means being embedded in the insulating member 4 in the center portion of the heat generating element 6, as shown in Fig. 9, so that electrodes 12 and 14 of the heat generating element 6 and lead wires 16 and 18 of the thermocouple 10, which are covered by a protective tube 20, are drawn from the bottom face of the ceramic container 8.

Therefore, in the above-described heater, when a current is allowed to flow through the heat generating resistance band 2 by applying a necessary voltage between the electrodes 12 and 14, Joule heat is generated by the current and a resistance derived from the heat generating resistance band 2, and this heat is used as a heating source. Here, the temperature of the generated heat is determined by the product ($R \cdot I^2$) of the resistance value (R) and the square of the value (I^2) of the current flowing thereinto; therefore, supposing that the

resistance value is constant, the current flowing thereinto is increased or reduced so that the temperature of heat generation can be controlled to an arbitrary value.

[Problems to be Solved by the Invention]

In the case of the heater formed by rolling up a heat generating resistance band 2 together with the insulating member 4, however, the following problems are raised:

(a) Since the heat generating resistance band 2 is rolled up with fixed intervals, the generated heat is applied in a synergetically increasing manner toward the center portion, with the result that the temperature distribution in heat generation of the heat generating element 6 has a temperature gradient with a higher temperature in the center portion and gradually decreasing temperatures toward the peripheral portion due to heat radiation. For this reason, it is difficult to provide an even surface temperature, and it is also very difficult to carry out electrical controls so as to provide an even temperature in heat generation.

(b) The heat generating element 6 uses heat generating resistance band 2 having a thickness of about 1.2 mm and a width of about 12 mm and, when the heat generating resistance band 2 is rolled up together with the insulating member 4, it becomes difficult to sandwich the insulating member 4 with even gaps from the viewpoint of production, and uneven gaps of the heat generating resistance band 2 also cause uneven diameters

in the heat generating element 6, resulting in poor reproducibility.

(c) The forming process of the heat generating resistance band 2 depends on a heat-molding process, and tends to cause defects in thermal strength, such as thermal deformation, disconnection and short-circuiting, due to thermal stress.

Therefore, an object of the invention is to provide a heater which provides an arbitrary temperature distribution in heat generation and improved thermal strength.

[Means for Solving the Problems]

As shown in Figs. 1 and 2, the heater of the invention is provided with a heat generating element 6 having a continuous band-shaped heat generating portion 24 formed on a plane with an arbitrary width.

[Functions]

As shown in Figs. 1 and 2, the heater of the invention has a band-shaped heat generating portion 24 that forms a heat generating element 6, and this portion is placed on a plane. Therefore, it becomes possible to effectively utilize heat radiation of the heat generating portion 24, and the width of the heat generating portion 24 can be adjusted to obtain an arbitrary heat generating distribution. In addition, since the heat generating element 6 needs no bending process or the like, it becomes possible to improve the thermal strength.

Moreover, in the heater of the invention, the heat

generating element 6 may have an arrangement in that the heat generating portion 24 is continuously formed by selectively forming gaps in a heat generating material plate having an arbitrary shape. Thus, the heat generating surface is allowed to effectively utilize heat generation from the heat generating material plate that is the original plate. Further, in comparison with the conventional arrangement in that the heat generating resistance band 2 is rolled up so that heat generation from the edge portions is utilized, it becomes possible to increase the temperature of heat generation per unit area, to set the temperature distribution of heat generation, and consequently to reduce the necessary area.

In the heater of the invention, the heat generating element 6 may have an arrangement in that the heat generating portion 24 is formed into a staggered shape, a spiral shape or a radial shape with an arbitrary width. Thus, an arbitrary temperature distribution is prepared, and it becomes possible to reduce the used amount of the heat generating material and also to reduce the necessary area.

[Embodiments]

Hereinafter, description will be given of embodiments of the invention with reference to the drawings.

Figs. 1 and 2 show an embodiment of a heater of the invention.

This heater has an arrangement in that an insulating

member 4 is housed in a bottomed, cylinder-shaped container 8 made of a heat-insulating material such as ceramics, and a plate-shaped heat generating element 6 is placed on the surface of the insulating member 4.

As shown in Fig. 3, the heat generating element 6 is prepared as a heat generating material plate having an arbitrary shape, that is, for example, an arrangement in that gaps 22 are selectively formed in a circular heat generating resistance plate 30 to form a continuous heat generating portion 24 having a band shape.

As shown in Fig. 3, the heat generating portion 24 of the heat generating element 6 is constituted by portions of the heat generating resistance plate 30 from which the gaps 22 are excluded. By narrowing the width of the gap 22, almost all the surface of the original shape of the heat generating material plate is allowed to serve as a heat generating face. Therefore, the shape and area of the heat generating element 6 can be determined in accordance with the shape and size of a subject to be heated, such as a semiconductor wafer.

Here, as shown in Fig. 2, electrodes 12 and 14 attached to the bottom face of the container 8 are connected to ends of the heat generating element 6 through heat generating resistance wires 26 and 28 as conduction means, and lead wires 16 and 18, which are drawn from a thermocouple 10 serving as a temperature detector, embedded in the insulating member 4 in

the center of the lower surface of the heat generating element 6, are drawn outside through a protective tube 20 attached to the bottom face of the container 8.

Therefore, when a current is allowed to flow through the heat generating element 6 by applying a voltage between the electrodes 12 and 14, the heat generating element 6 is heated by the current; thus, the temperature of heat generation is detected by the thermocouple 10, and the resulting detection data is taken out from the lead wires 16 and 18 and is utilized for temperature control.

In this arrangement of the heat generating element 6, by adjusting the formation position and range of the gaps 22, it is possible to provide arbitrary temperature distributions of heat generation, such as an even distribution of the temperature in heat generation and a partially different distribution of the temperature in heat generation; thus, it becomes possible to reduce the used amount of the heat generating material and also to reduce the necessary area.

For example, as shown in Fig. 4, the heat generating element 6 divides the circular heat generating resistance plate 30 used as the heat generating material plate into two regions in the diameter direction, and the gaps 22 are selectively formed in each of the regions so as to provide a band-shaped heat generating portion 24 having a staggered form. Therefore, almost all the original form of the circular heat generating

resistance plate 30 is used as the heat generating surface, thereby making it possible to provide an even temperature distribution in heat generation, and consequently to increase the temperature per unit area.

As shown in Fig. 4, with respect to the heat generating element 6, gaps 22 are formed in a circular heat generating resistance plate 30 selected as the heat generating material plate, through a cutting process, such as a wire-cut discharging process and a laser process, in a manner as indicated by a broken line; thus, it is possible to prepare a band-shaped heat generating portion 24 formed by bending a sheet of heat generating resistance plate 30 into a staggered shape. In accordance with such a processing method, it is possible to provide a heater which has high precision in dimension and superior reproducibility, and is capable of desirably setting the shape of the heat generating portion 24 so as to provide various kinds of heat generating distributions. Here, with respect to the forming process of the heat generating element 6, in addition to the wire-cut discharging process and the laser process, various processing methods, such as a machining process and a press-working operation, may be used as means for processing the heat generating portion 24 into an arbitrary shape.

As shown in Fig. 5, the heat generating element 6 can be constituted by two heat generating element pieces 6A and 6B. Each of the heat generating element pieces 6A and 6B is formed

as follows. After cutting a heat generating resistance band into a rectangular shape, a plurality of these bands are superposed, and gaps 22 are cut off to form heat generating portions 24 having a staggered shape, and a connecting portion 32 and a terminal portion 34 are formed in each of the ends thereof. In this case, a through hole 36 through which the heat generating resistance wires 26 and 28 serving as conductive wires are connected is formed in the terminal portion 34. Then, the two heat generating element pieces 6A and 6B are placed symmetrically so that the respective terminal portions 34 are aligned face to face with each other, and the respective connecting portions 32 are connected to each other through welding or the like so that a circular heat generating element 6 is formed. When the circular heat generating element 6 is formed by these heat generating element pieces 6A and 6B, the heat generating resistance plate 30 is formed by using such a heat generating element 6 having a narrowed radial width so that it is possible to reduce the necessary heat generating material plate and also to increase the yield of production.

Moreover, as shown in Fig. 6, the heat generating element 6 may be prepared as a heat generating portion 24 formed into a staggered shape like arcs, and a connecting portion 32 is placed in the center thereof so as to connect the heat generating element pieces 6A and 6B. In this case, supposing that the widths of the heat generating portions 24 are a, b, c, d, e, f, g

and h and that the width of the gaps 22 is i, the width i is set to a constant value, with the gaps of the heat generating portions 24 being set so as to satisfy, for example, a > b > c > d > e > f > g > h, so that the resistance value of the heat generating portions 24 is gradually lowered toward the peripheral portion. Thus, it becomes possible to provide an even temperature distribution of heat generation of the heat generating element 6 by compensating for the temperature of heat radiation. Here, the widths of the heat generating portions 24 may be set to three levels, such as a (= b = c = d) > e (= f) > g (=h).

In addition, the shape of the heat generating portion 24 of the heat generating element 6 may be designed to various shapes such as a radial shape or a spiral shape, and the width thereof may be desirably adjusted to provide an arbitrary temperature distribution.

Here, in the case where this heater is used for heating a semiconductor wafer, as shown in Fig. 7, a quartz plate 38 is placed on the heat generating face of the heater, and a heat conductive plate 40, such as a carbon (SiC) plate, which has superior thermal conductivity and evenly transmits heat, is placed on the quartz plate 38, and a semiconductor wafer 42, which is a subject to be heated, is placed thereon so as to carry out a heating process.

Here, in the embodiment, the outer circumferential shape of the heat generating element 6 is a circular shape with the

heat radiation face of the heater being also formed into a circular shape; however, in the case where the heat radiation face is designed in accordance with the shape of the subject to be heated, the heat generating element 6 may have an arbitrary shape, such as a square shape and a triangular shape, that corresponds to the heat radiation face, or a plurality of heat generating elements 6 having arbitrary shapes may be combined in response to the heat radiation face. In these cases, the distribution of heat generation may be set in a manner so as to have locally different values.

[Effects of the Invention]

As described above, the invention provides the following effects.

(a) Since heat generating portions each having an arbitrary width are formed as a flat surface by using a plate-shaped heat generating element, it is possible to increase the heat generating efficiency and, also, to provide an arbitrary temperature distribution in heat generation. Thus, it becomes possible to improve the dimensional precision in the heat generating face, to prevent occurrences of deformation, disconnection and short-circuiting due to heat, and consequently to increase the thermal strength.

(b) The heat generating element allows the original surface of a heat generating material plate to entirely serve as a heat generating portion; therefore, it is possible to provide a

high temperature in heat generation per unit area, to increase the heat generating efficiency, to reduce the used amount of the heat generating element with respect to the effective temperature, and consequently to reduce the necessary area.

(c) Since the heat generating element is formed into a given shape, it is possible to apply the element to various types of subjects to be heated that have various shapes and sizes, and consequently to improve the degree of freedom in designing heaters.

4. Brief Description of the Drawings

Fig. 1 is a perspective view that shows an embodiment of a heater in accordance with the invention, Fig. 2 is a vertical sectional view of the heater shown in Fig. 1, Fig. 3 is a perspective view that shows a shape of a heat generating element of the heater shown in Fig. 1, Fig. 4 is a perspective view that shows a forming method of the heat generating element of the heater shown in Fig. 1, Figs. 5 and 6 are plan views that show specific shapes of the heat generating element, Fig. 7 is a side view that shows a case where a semiconductor wafer is heated by using the heater shown in Fig. 1, Fig. 8 is a perspective view that shows a conventional heater, and Fig. 9 is a partially exploded perspective view that shows a state where ends of a heat generating resistance band and a thermocouple are placed in the heater shown in Fig. 6.

6... heat generating element, 22... gap, 24... heat

generating portion

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⑤発明の名称　加熱器

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明　細　書

1．発明の名称

加熱器

2．特許請求の範囲

(1)　平面上に任意幅でかつ連続した帯状の発熱部分を形成した発熱エレメントを設置してなることを特徴とする加熱器。

(2)　前記発熱エレメントは、任意形状の発熱素材板に選択的に間隙を形成して連続した前記発熱部分を設けたことを特徴とする特許請求の範囲第1項に記載の加熱器。

(2)　前記発熱エレメントは、前記発熱部分を任意幅で千鳥状、螺旋状、放射状に形成したことを特徴とする特許請求の範囲第1項に記載の加熱器。

3．発明の詳細な説明

〔産業上の利用分野〕

この発明は、半導体ウエーハなどの被加熱物を加熱する加熱器に係り、特に、発熱エレメントの発熱部分の形態に関する。

〔従来の技術〕

従来、ガリウム－砒素、燐－アルミニウムなどからなる半導体ウエーハの加熱処理は、たとえば、第8図に示す加熱器が加熱源に用いられる。

この加熱器は、通電によって発熱する発熱抵抗体を帯状に形成した発熱抵抗帯2を絶縁材4を介在させて巻き込むことによって発熱エレメント6を形成し、この発熱エレメント6をセラミック容器8に収容するとともに、この発熱エレメント6の中央部分の絶縁材4の中に、第9図に示すように、温度検出手段としての熱電対10を埋め込み、セラミック容器8の底面から発熱エレメント6の電極12、14および熱電対10のリードワイヤ16、18を保護筒20で覆って引き出したものである。

したがって、このような加熱器では、電極12、14間に必要な電圧を印加して発熱抵抗帯2に電流を流すと、その電流と発熱抵抗帯2の持つ抵抗によってジュール熱を生じるので、この熱を加熱源としている。そして、この発熱温度は、抵抗値

（R）と流し込む電流値の二乗（I^2）との積（$R \cdot I^2$）で決定されるから、抵抗値を一定とした場合、流し込む電流を加減して任意の発熱温度に制御することができる。

〔発明が解決しようとする問題点〕

ところで、発熱抵抗帯2を絶縁材4とともに巻き込んで形成された加熱器では、次のような欠点がある。

(a) 発熱抵抗帯2を一定の間隔で巻き込んでいるため、その中央部に近づくに従って発生した熱が相乗的に加わり、発熱エレメント6の発熱温度分布は、中央部分が高く、周縁部に行くに従って放熱のため温度が低下する温度傾斜を生じる。このため、表面温度の均一化が困難であり、発熱温度を均一化するための電気的な制御も非常に面倒である。

(b) 発熱エレメント6は、たとえば、1.2mm厚で12mm幅程度の発熱抵抗帯2を用いており、この発熱抵抗帯2を絶縁材4とともに巻き込む場合、生産上で絶縁材4を一様な間隔に挟み込むことが困難であり、このため、発熱抵抗帯2の間隔が不均一になると、発熱エレメント6の直径も均一にすることができず、再現性が悪い。

(c) また、発熱抵抗帯2の加工は、加熱成形によっており、熱的ストレスのため、熱的変形、断線あるいは短絡など、熱的強度が低い欠点がある。

そこで、この発明は、任意の発熱温度分布を得るとともに、熱的強度を改善した加熱器を提供しようとするものである。

〔発明が解決しようとする問題点〕

この発明の加熱器は、第1図および第2図に示すように、平面上に任意幅でかつ連続した帯状の発熱部分24を形成した発熱エレメント6を設置したものである。

〔作　　用〕

この発明の加熱器では、第1図および第2図に示すように、発熱エレメント6を形成する発熱部分24が帯状で、それを平面状に配置しているため、発熱部分24の熱放射を効率的に利用でき、また、発熱部分24の幅を任意に調整して任意の発熱分布が得られ、また、発熱エレメント6は曲げ加工などを要しないため、熱的強度の改善が図られる。

そして、この発明の加熱器において、発熱エレメント6は、任意形状の発熱素材板に選択的に間隙を形成して帯状の連続した発熱部分24を設ければ、その発熱面が原形の発熱素材板からの発熱を効率的に利用することができ、従来の発熱抵抗帯2を巻き込んで、その縁部からの発熱を利用する場合に比較して、単位面積当たりの発熱温度を高めることができるとともに、発熱温度分布を任意に設定でき、省面積化を図ることができる。

そして、この発明の加熱器において、発熱エレメント6は、発熱部分24を任意幅で千鳥状、螺旋状、放射状に形成すれば、任意の温度分布に設定できるとともに、発熱素材の使用量の低減、省面積化などを図ることができる。

〔実　施　例〕

以下、この発明の実施例を図面を参照して説明する。

第1図および第2図は、この発明の加熱器の実施例を示す。

この加熱器は、セラミックなどの断熱材を用いて形成された有底円筒状の容器8に絶縁材4を収容し、その絶縁材4の表面部に板状の発熱エレメント6を設置したものである。

発熱エレメント6は、任意形状の発熱素材板として、第3図に示すように、たとえば、円形の発熱抵抗板30に選択的に間隙22を形成して帯状の連続した発熱部分24を設けたものである。

発熱エレメント6の発熱部分24は、第3図に示すように、発熱抵抗板30に形成した間隙22を除いた部分からなり、間隙22の幅を細くするたとによって、発熱素材板の原形のほぼ全面を発熱面とすることができる。したがって、発熱エレメント6の形状や面積は、半導体ウエーハなどの被加熱物の形状や大きさに対応して設定するものとする。

そして、第2図に示すように、容器8の底面に取り付けた電極12、14と、発熱エレメント6

の端部とを導電手段として発熱抵抗線２６、２８を介して接続するとともに、発熱エレメント６の中央下面部の絶縁材４に埋め込んだ温度検出器としての熱電対１０から引き出したリードワイヤ１６、１８を、容器８の底面に取り付けた保護筒２０から外部に引き出している。

したがって、電極１２、１４の間に電圧を印加して電流を発熱エレメント６に流し込むと、その電流によって発熱エレメント６が発熱し、その発熱温度を熱電対１０によって検出し、その検出データをリードワイヤ１６、１８から取り出して温度制御に利用することができる。

このように発熱エレメント６を構成すれば、間隙２２の形成位置や範囲を調整して、発熱温度分布の均一化や部分的に異なる温度分布の設定など、任意の発熱温度分布を設定し、発熱素材の節減を図ることができるとともに、省面積化を図ることができる。

発熱エレメント６は、たとえば、第４図に示すように、発熱素材板として用いた円形の発熱抵抗板３０を直径方向に二分する範囲とし、各範囲に選択的に間隙２２を形成して千鳥状に帯状の発熱部分２４を形成しているので、円形の発熱抵抗板３０の原形をほぼ全面的に発熱面に設定でき、発熱温度分布の均一化、単位面積当たりの温度を高めることができる。

この発熱エレメント６は、第４図に示すように、発熱素材板として選択された円形の発熱抵抗板３０に、たとえば、ワイヤカット放電加工やレーザー加工などの切断加工によって破線で示すように間隙２２を形成すれば、一枚の発熱抵抗板３０を千鳥状に屈曲した帯状の発熱部分２４に形成することができる。このような加工方法によれば、寸法精度の高い、しかも再現性がよく、被加熱物に対応して、発熱部分２４の形状を任意に設定し、多種多用の発熱分布を持つものを得ることができる。なお、発熱エレメント６の成形加工は、ワイヤカット放電加工やレーザー加工の他、発熱部分２４を任意形状に加工できる手段として切削加工やプレス加工などの各種の加工法を用いることができる。

発熱エレメント６は、第５図に示すように、２つの発熱エレメント片６Ａ、６Ｂから構成することができる。各発熱エレメント片６Ａ、６Ｂは発熱抵抗帯を長方形に切断した後、その複数枚を重ね合わせて間隙２２を切り落として千鳥状の発熱部分２４を形成するとともに、各端部に接続部３２および端子部３４を形成したものである。この場合、端子部３４には導電ワイヤとしての発熱抵抗線２６、２８を接続するための貫通孔３６を形成する。そして、２枚の発熱エレメント片６Ａ、６Ｂを対称にて配置して各端子部３４を対向させるとともに、各接続部３２を溶接などによって接続し、円形の発熱エレメント６を形成する。このような発熱エレメント片６Ａ、６Ｂから円形の発熱エレメント６を形成すると、発熱抵抗板３０は発熱エレメント６の半径幅の幅の狭いものを用いることができ、発熱材料板の節減とともに、製造上の歩留りを高めることができる。

また、発熱エレメント６は、第６図に示すように、円弧を描いて千鳥状に発熱部分２４を形成してもよく、その中央部に接続部３２を設けて、各発熱エレメント片６Ａ、６Ｂを接続する。この場合、発熱部分２４の幅をａ、ｂ、ｃ、ｄ、ｅ、ｆ、ｇ、ｈ、間隙２２の幅をｉとすると、幅ｉを一定に設定し、発熱部分２４の幅をたとえば、ａ＞ｂ＞ｃ＞ｄ＞ｅ＞ｆ＞ｇ＞ｈに設定して、発熱部分２４の抵抗値を周辺部に行くに従って段階的に低く設定することにより、放熱温度を補償して発熱エレメント６の発熱温度分布を均一化することができる。また、発熱部分２４の幅は、たとえば、ａ（＝ｂ＝ｃ＝ｄ）＞ｅ（＝ｆ）＞ｇ（＝ｈ）のように３段階に設定してもよい。

その他、発熱エレメント６の発熱部分２４の形態は、放射状あるいは螺旋状など、種々の形態に設定するとともに、その幅を任意に調整して所望の温度分布を得ることができる。

そして、この加熱器を用いて半導体ウエーハを加熱する場合には、第７図に示すように、加熱器の発熱面上に石英板３８を載置し、その石英板

３８の上にカーボン（ＳｉＣ）板などの熱伝導が良好で熱を均等に伝達する熱伝導板４０を載置した上に、被加熱物としての半導体ウエーハ４２を設置してその加熱を行う。

なお、実施例では発熱エレメント６の外周形状を円形にして加熱器の熱放射面を円形に設定したが、熱放射面は被加熱物の形状に合わせて設定する場合に、発熱エレメント６はその熱放射面に合わせた四角、三角などの任意形状にし、または、その熱放射面に対応して複数の任意形状の発熱エレメント６を組み合わせてもよい。その場合、発熱温度分布は局所的に異ならせて設定することも可能である。

〔発明の効果〕

以上説明したように、この発明によれば、次のような効果が得られる。

(a) 板状の発熱エレメントによって、任意幅の発熱部分を平面状に形成しているので、発熱効率を高め、任意の発熱温度分布を得ることができ、発熱面の寸法精度を高め、熱的な変形、断線、短絡などの発生が防止でき、熱的強度を高めることができる。

(b) 発熱エレメントは、たとえば、発熱素材板の原形面を全面的に発熱部分とすることができるので、単位面積当たりの発熱温度が高く、発熱効率を高めることができるとともに、実効温度に対する発熱素材の使用量を節減することができ、省面積化を図ることができる。

(c) 発熱エレメントは任意の形状に形成できるので、多種多用の被加熱物の形状や大きさに対応でき、加熱設計の自由度が高められる。

４．図面の簡単な説明

第１図はこの発明の加熱器の実施例を示す斜視図、第２図は第１図に示した加熱器の縦断面図、第３図は第１図に示した加熱器の発熱エレメントの形状を示す斜視図、第４図は第１図に示した加熱器の発熱エレメントの形成方法を示す斜視図、第５図および第６図は発熱エレメントの具体的な形態を示す平面図、第７図は第１図に示した加熱器を用いて半導体ウエーハを加熱する場合を示す側面図、第８図は従来の加熱器を示す斜視図、第９図は第６図に示した加熱器における発熱抵抗帯の端部および熱電対の設置状況を示す一部切欠斜視図である。

６・・・発熱エレメント、２２・・・間隙、２４・・・発熱部分。

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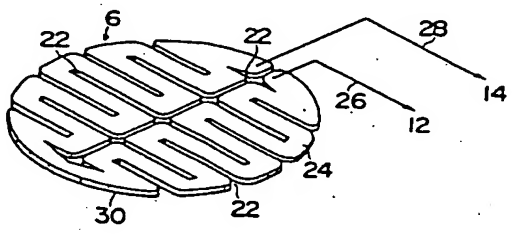
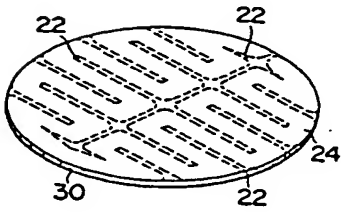


第３図



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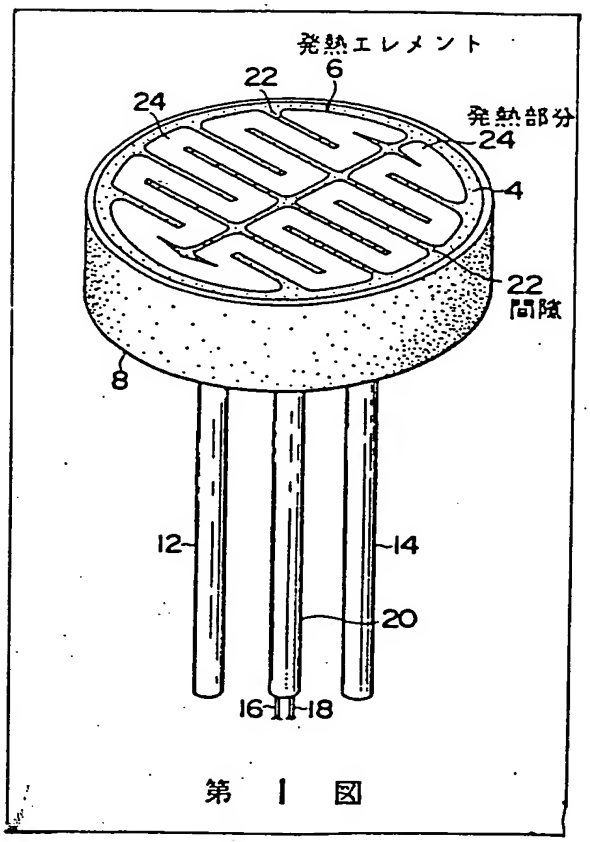

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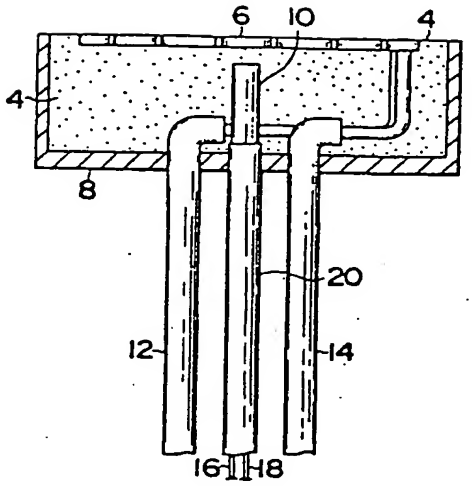

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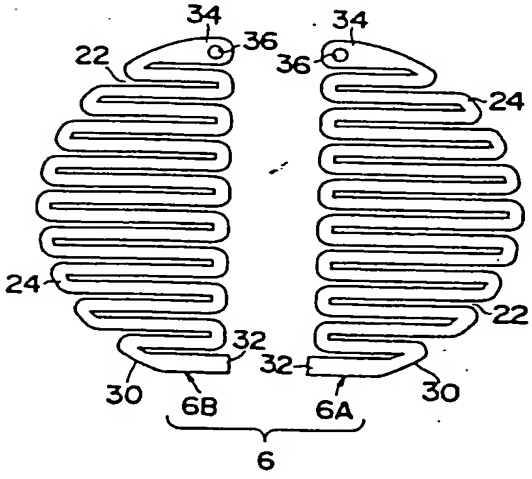

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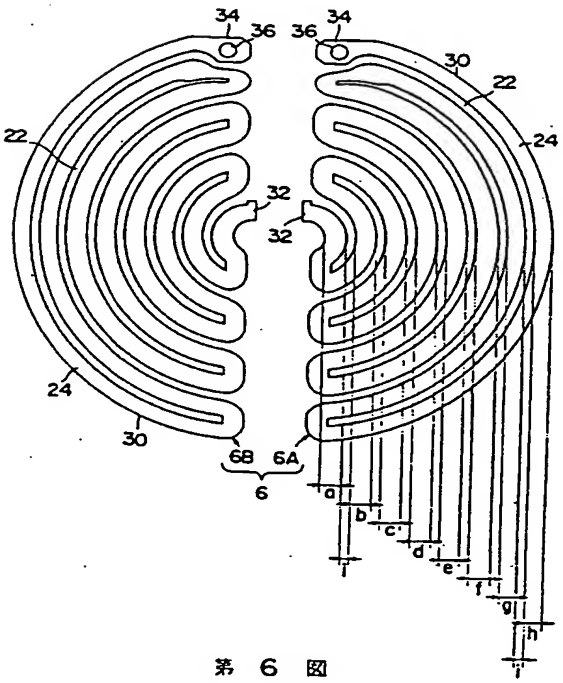

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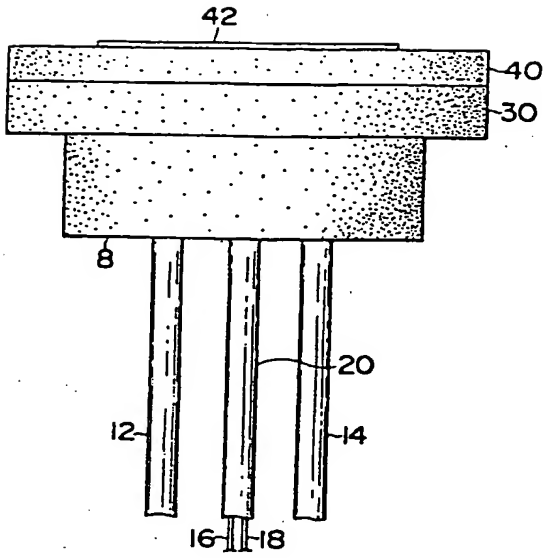

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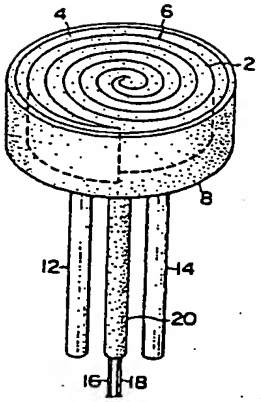

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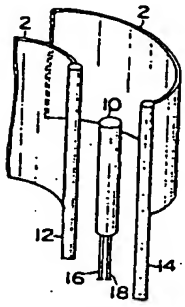

第 9 図